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Multiple Colonization of a Bivalve-Inhabiting Hydroid *Eugymnanthea japonica* (Leptomedusae: Eirenidae) in Japan

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With Tables 1–2

Abstract Mature medusae of both sexes of *Eugymnanthea japonica* are released from a total of 30 out of 93 host bivalve specimens of three species collected from eight out of 12 localities sampled in Japan, showing the multiple colonization of this hydroid species. Including the above 30 hosts, 62 hosts harbored female and 61 hosts harbored male, suggesting an equal chance of settlement to the host by either sex if only a very small number of individuals colonize a host.

Key words: *Eugymnanthea japonica*, sex of mature medusa, multiple colonization, host bivalve, Japan

Introduction

In my previous laboratory observations on the hydroids commensal with bivalves in Japan, now known as *Eutima japonica* Uchida and *Eugymnanthea japonica* Kubota (see Kubota, 1991, 1992a), 3–24 (10 ± 10SD, N=4) planula larvae of the northern form of *Eutima japonica* from Oshoro, Hokkaido could attach to the soft body portions of *Mytilus edulis galloprovincialis* (Kubota, 1983, pp. 366–368) and mature medusae of both sexes of *Eugymnanthea japonica* were released in one host specimen (*Crassostrea gigas*) from Zagashima Island, Mie Prefecture (Kubota, unpubl. data, *cf.* Kubota, 1985) and in several host specimens (*M. edulis galloprovincialis*) from Shimizu, Shizuoka Prefecture (Kubota, 1987b, p. 8). Succeeding to these preliminary observations, the present study has been conducted to demonstrate the multiple colonization of *Eugymnanthea japonica*, combining with the previous records (Kubota, 1979, 1987a, 1991, 1992b, c).

Material and Methods

A total of 93 host bivalve specimens of three species were examined. They were collected mostly intertidally from 1977 to 1993, and from 12 localities in Japan, covering the range of *Eugymnanthea japonica* (Table 1). Associated hydroids picked up from each host specimen or each host specimen harbored the hydroids were reared in artificial seawater or in filtered natural seawater from Oshoro, Hokkaido or Shirahama, Wakayama Prefecture at 20–26°C for up to 605 days. The hydroids and hosts were fed with newly hatched *Artemia* nauplii when they were reared for a long time.

The sex of medusae was determined in as many fresh specimens as possible in each colony under a binocular microscope or a microscope, sometimes preventing the discharge of gametes by illumination of fluorescent light at night (Appendices 1, 2). A total of 2127 female medusae and 1520 male medusae were examined (Table 2). All medusae have gonads of either sex, showing no hermaphroditism.

Table 1. Host specimens of *Eugymnanthea japonica* examined.

Locality (Prefecture)	Host bivalve species M: *Mytilus* C: *Crassostrea*	No. of host specimens	Substrata	Date
Atami (Shizuoka)	*M. edulis galloprovincialis*	17	raft	23–IX–'89
Nishikigaura (Shizuoka)	*M. edulis galloprovincialis*	1	anchor[6]	1–XII–'90
Shimoda (Shizuoka)	*M. edulis galloprovincialis*	2[2]	raft	23, 25–VIII–'77
	M. edulis galloprovincialis	3	raft	13–V–'87
Shimizu (Shizuoka)	*M. edulis galloprovincialis*	8[3]	concrete	2, 3–XII–'85
Zagashima Island (Mie)	*M. edulis galloprovincialis*	1[4]	rope	11～13–IX–'84
	C. gigas	1[4]	rope	22～26–XI–'82
Shirahama (Wakayama)	*M. edulis galloprovincialis*	6	raft	31–VII–'92
	M. edulis galloprovincialis	5	rock	12–VI–'93
	C. gigas	3	rock	25–XII–'87
Kushi (Kagoshima)	*M. edulis galloprovincialis*	2	raft, rope	25–VIII–'87
Akune (Kagoshima)	*M. edulis galloprovincialis*	2	rock	28–VIII–'87
Gounoura, Iki Island (Nagasaki)	*M. edulis galloprovincialis*	1	raft	8–VIII–'88
Takeshiki, Tsushima Island (Nagasaki)	*M. edulis galloprovincialis*	7	raft, rock	10, 11–VIII–'88
	M. edulis galloprovincialis	9	rock	21–VIII–'92
Yagaji, Okinawa Island (Okinawa)	*C. vitrefacta*	1[5]	pebble	16–IX–'86
	C. vitrefacta	3	pebble	26–III–'90
Ishikawa[1], Okinawa Island (Okinawa)	*C. gigas*	21	rock	15–V–'91

1) New record of occurrence. 2) Kubota, 1979. 3) Kubota, 1987b. 4) Kubota, 1985. 5) Kubota, 1987a. 6) Only this substratum is in deeper waters, 20 m in depth (see Kubota, 1992b); the others are intertidal or upper subtidal.

A large number of other host specimens have been examined, but only less than ten medusae of either sex were obtained from them; such hosts and medusae were not included in the present result.

Results and Discussion

A total of 30 out of 93 host specimens of various sizes harbored both sexes (Table 2, Appendices 1, 2), showing the multiple colonization of *Eugymnanthea japonica*. Such a multiple colonization of this species takes place in every host bivalve species examined irrespective of introduced (*Mytilus edulis galloprovincialis*) or native hosts (*Crassostrea gigas* and *C. vitrefacta*), and it was observed in most of the localities surveyed (8/12, Table 2).

Only female medusae were released from 32 host specimens and only male medusae were from 31 host specimens (Table 2). Including the above 30 hosts harbored both sexes, female medusae were released from a total of 62 host specimens and male medusae were from 61 ones (Table 2). If only one or a very small number of individuals colonize a host, it can be assumed that the chance of settlement of either sex of this species is not much different.

The two hydroid species, *Eugymnanthea japonica* and *Eutima japonica* colonized one host specimen at Takeshiki, Tsushima Island, Nagasaki Prefecture (Appendix 2, asterisked). Such a multiple colonization is the third record in Japan (see Kubota,

Table 2. The frequency of multiple colonization of *Eugymnanthea japonica* in three bivalve species in Japan (*cf.* Appendices 1, 2).

Locality	Host species*	No. of host specimens which released medusae of:			No. of mature medusae examined:	
		Female + Male	Female	Male	Female	Male
Atami	*Meg*	5	6	6	106	101
Nishikigaura	*Meg*	1	0	0	1	6
Shimoda	*Meg*	0	3	2	72	39
Shimizu	*Meg*	5	3	0	385	121
Zagashima Island	*Meg*	0	1	0	63	0
	Cg	1	0	0	10	3
Shirahama	*Meg*	2	6	3	769	332
	Cg	1	0	2	8	44
Kushi	*Meg*	0	1	1	13	24
Akune	*Meg*	0	2	0	42	0
Gounoura	*Meg*	0	1	0	68	0
Takeshiki	*Meg*	6	4	6	242	227
Yagaji	*Cv*	1	1	2	79	77
Ishikawa	*Cg*	8	4	9	269	546

* *Meg*: *Mytilus edulis galloprovincialis*; *Cg*: *Crassostrea gigas*; *Cv*: *Crassostrea vitrefacta*.

1992c, pp. 155–156). In this host both sexes of *Eugymnanthea japonica* colonized. Therefore, at least three planula larvae, two *Eugymnanthea japonica* and one *Eutima japonica*, settled on this host at the same time or at different developmental stage of this host, since the sex reversal is very rare in hydrozoans and the sex may be already determined in the larval stage. Another possibility of this multiple colonization is due to invasion of hydroid(s) which set free after settlement on the initial host specimen(s), deducing from the observations that release of hydroids from a host and their re-attachment on the rearing vessel have been observed in the laboratory (Kubota, 1983, pp. 325–326, unpubl. data).

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Appendix 1. Number of female and/or male medusae of *Eugymnanthea japonica* released from each host specimen of two species of *Crassostrea* in Japan.

Locality (host bivalve species)	No. of medusae released: Female	Male	Sex undetermined	Period of examination in days
Zagashima Island (*C. gigas*)	10	3	2	3
Shirahama (*C. gigas*)	8	8	9	39
	0	18	68	56
	0	18	11	75
Yagaji (*C. vitrefacta*)	9	1	5	4
	0	46	7	6
	0	30	14	3
	70	0	4	36[1)]
Ishikawa (*C. gigas*)	3	41	1	40
	16	28	58	31
	11	28	25	37
	14	8	34	36
	3	16	0	7
	4	10	33	17
	12	2	1	43
	2	2	19	35
	0	117	7	39
	0	74	1	41
	0	72	6	25
	0	37	1	10
	0	31	3	7
	0	24	2	37
	0	23	24	31
	0	18	5	9
	0	15	3	40
	75	0	5	26
	63	0	8	25
	52	0	4	37
	14	0	3	10

1): *cf.* Kubota, 1987a.

Appendix 2. Number of female and/or male medusae of *Eugymnanthea japonica* released from each host specimen of *Mytilus edulis galloprovincialis* in Japan.

Locality	No. of medusae released: Female	Male	Sex undetermined	Period of examination in days
Atami	2	26	0	1
	10	2	0	1
	7	3	0	1
	9	1	0	1
	1	2	6	1
	0	13	0	1
	0	12	0	1
	0	12	0	1
	0	10	0	1
	0	10	0	1
	0	10	0	1
	16	0	0	1
	14	0	0	1
	14	0	0	1
	13	0	0	1
	10	0	0	1
	10	0	0	1
Nishikigaura	1	6	1	4
Shimoda	38	0	68	14
	18	0	54	15
	16[1)]	0	-	6
	0	27	147	11
	0	12[1)]	-	31
Shimizu	34	57	11	114
	4	29	3	113
	3	29	10	60
	1	2	7	58
	1	4	0	89
	214	0	14	377
	114	0	10	87
	14	0	7	54
Zagashima Island	63	0	0	2
Shirahama	81	58	3	3
	8	1	0	7
	207	0	10	5
	178	0	15	2
	166	0	2	3
	0	113	0	8
	0	108	3	7
	0	52	13	2
	67	0	0	3
	33	0	0	7
	29	0	0	7
Kushi	0	24	44	6
	13	0	46	6
Akune	29	0	7	1
	13	0	3	1
Gounoura	68	0	2	14
Takeshiki	65	64	72	10
	17	14	8	10*
	8	8	4	4
	2	10	15	2
	1	4	2	3
	2	1	1	3
	0	40	62	605
	0	28	41	119
	0	18	1	94
	0	14	0	111
	0	13	26	111
	0	13	3	9
	106	0	11	18
	14	0	6	112
	14	0	7	7
	13	0	0	1

*: Six immature medusae of *Eutima japonica* (the *intermedia* form) were released besides 39 medusae of *Eugymnanthea japonica*.
1): *cf.* Kubota, 1979. -: no data.